San Diego Drought Workshop

June 30, 2009

Overview of Groundwater in San Diego County

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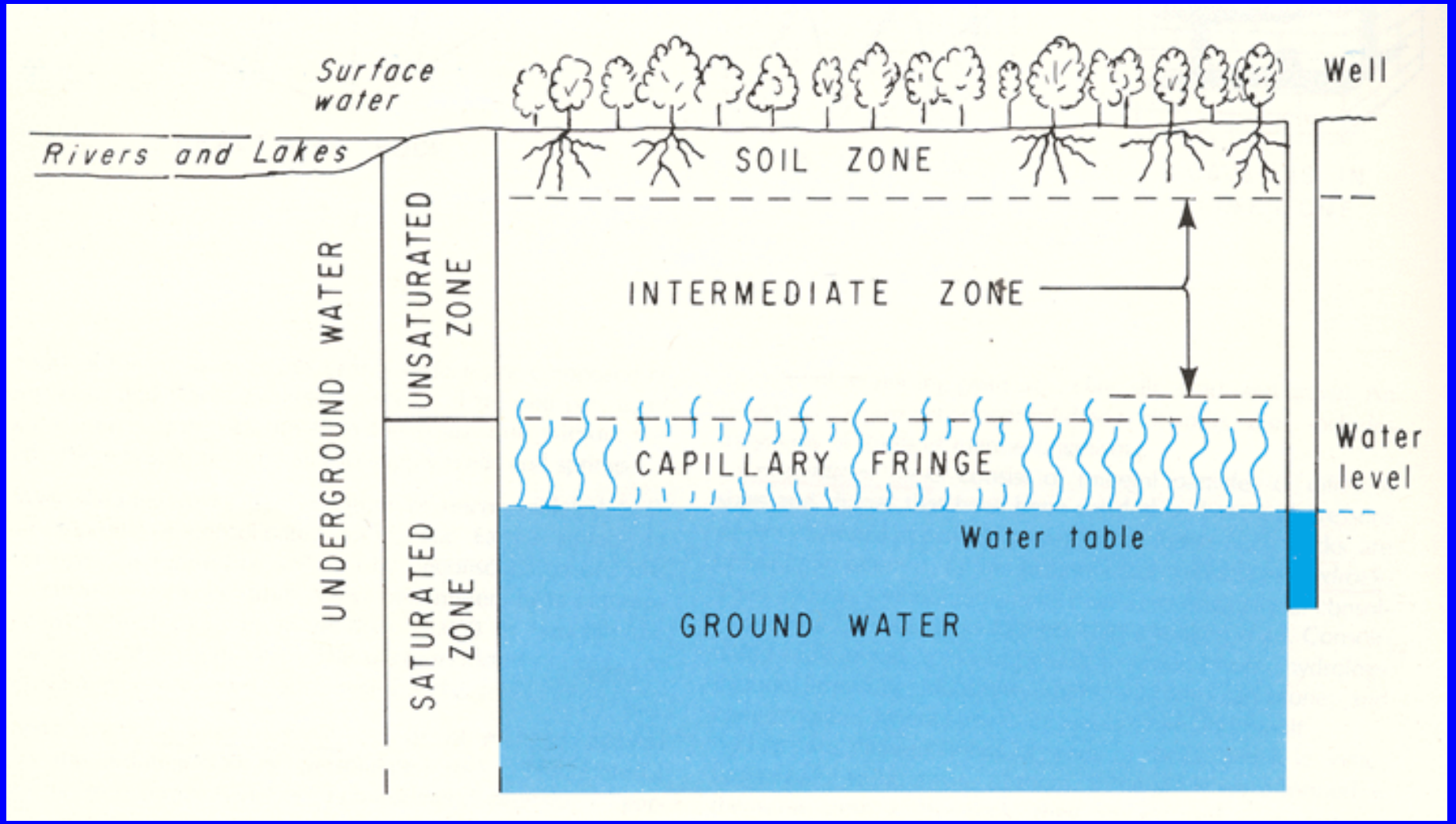
California Department of Water Resources

Southern District

Hydrologic Cycle

- Groundwater is part of the hydrologic cycle

Groundwater



Heath, 1983, *Basic Ground-Water Hydrology*

Global Distribution of Water

Oceans	97.1%
Ice Caps & Glaciers	2.24%
Groundwater	0.612%
Atmosphere, Lakes, & Rivers	0.0189%

California's Groundwater

- In California, groundwater provides:
  - About 30% of water supply in normal years.
  - More than 40% in dry years.

California's Groundwater, DWR Bulletin 118 – Update 2003

What controls the occurrence and availability of groundwater?

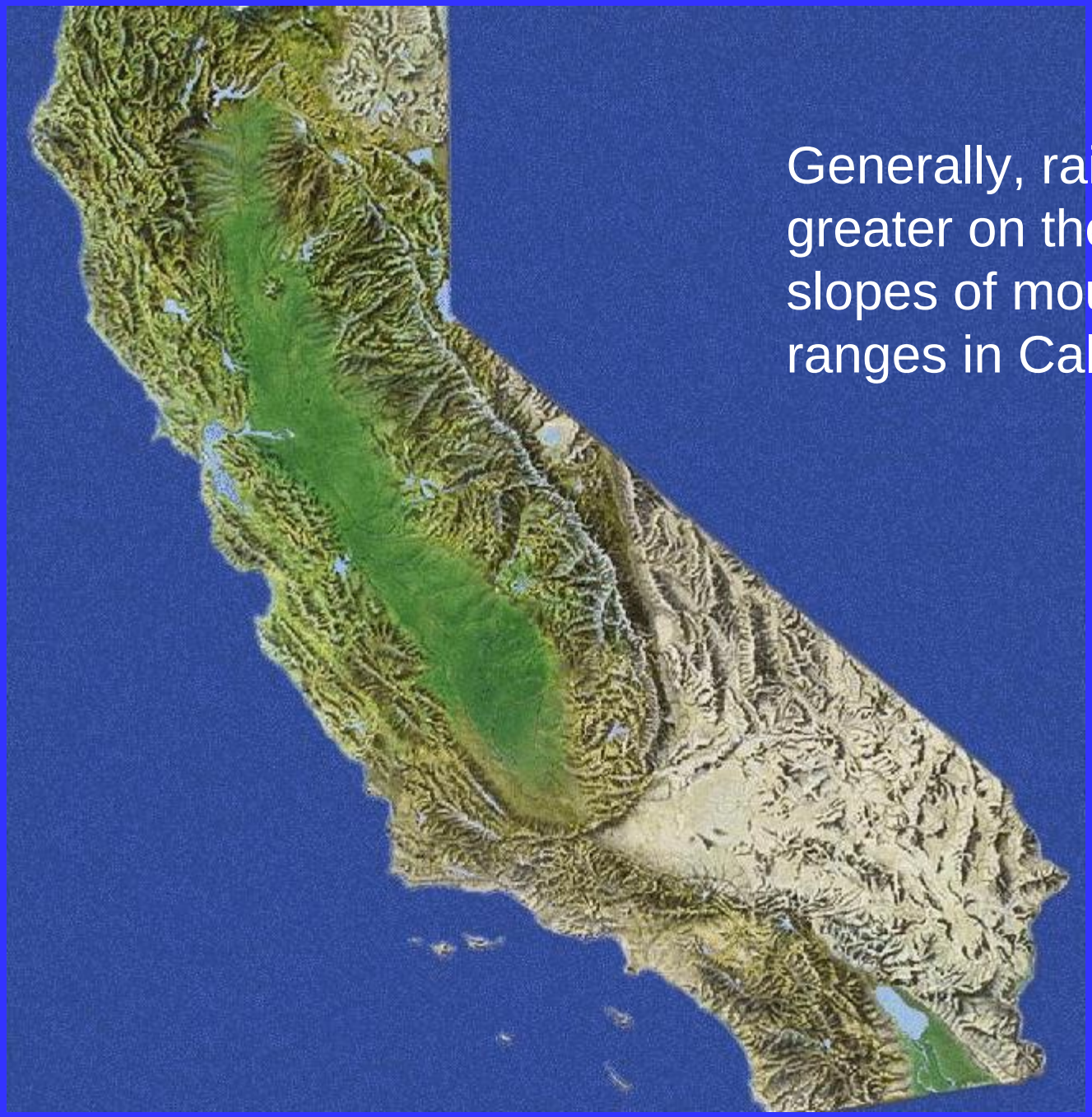
Groundwater

- Climate (precipitation) controls the availability of water in an area.
- Geology (rock type & structure) controls the capacity to store groundwater.

Precipitation

Precipitation

- Mean annual precipitation is relatively low in southern California.
- Commonly, 25 to 40 percent departure from the mean.



Generally, rainfall is greater on the coastal slopes of mountain ranges in California

Groundwater & Climate

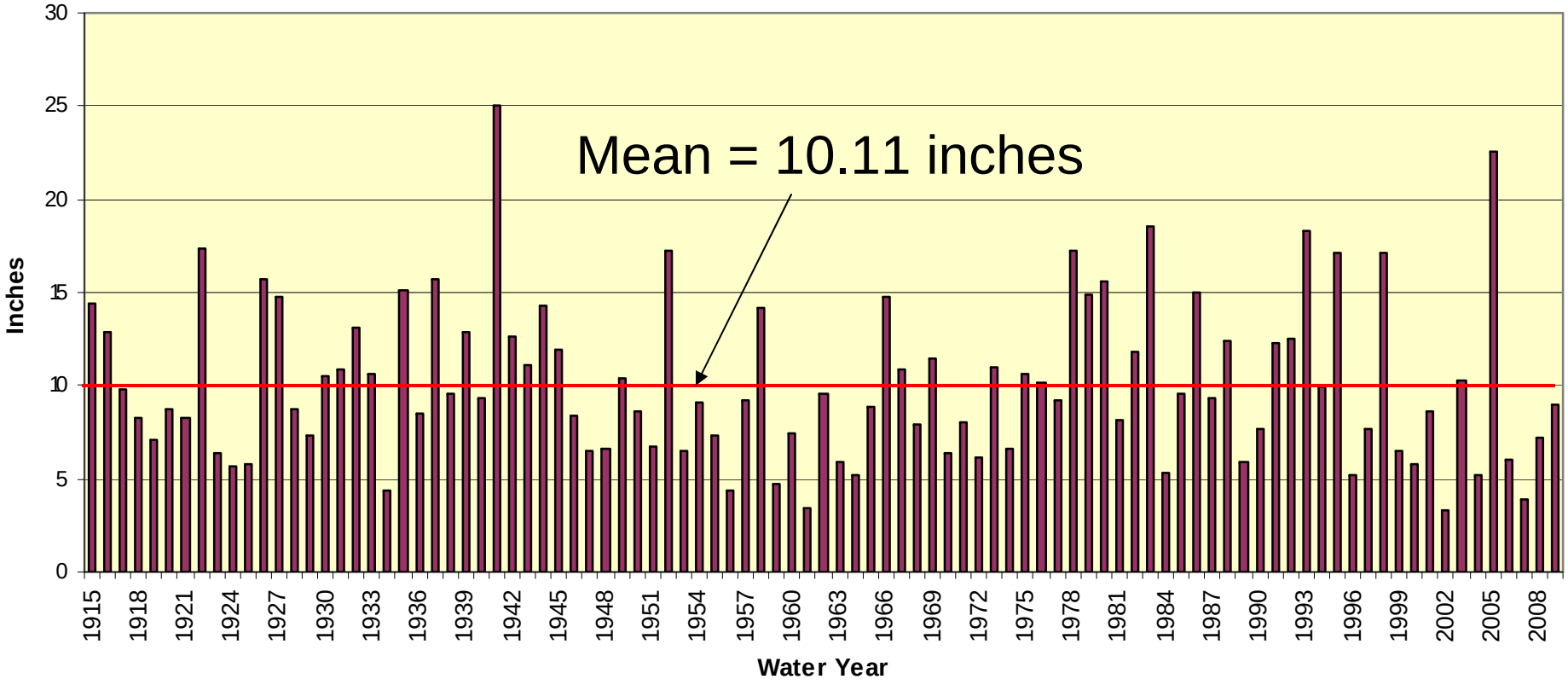
In humid region or during wet period, the depth to groundwater is relatively shallow.

In arid region or during dry period, the depth to groundwater is relatively deep.

How much rain falls in San Diego?

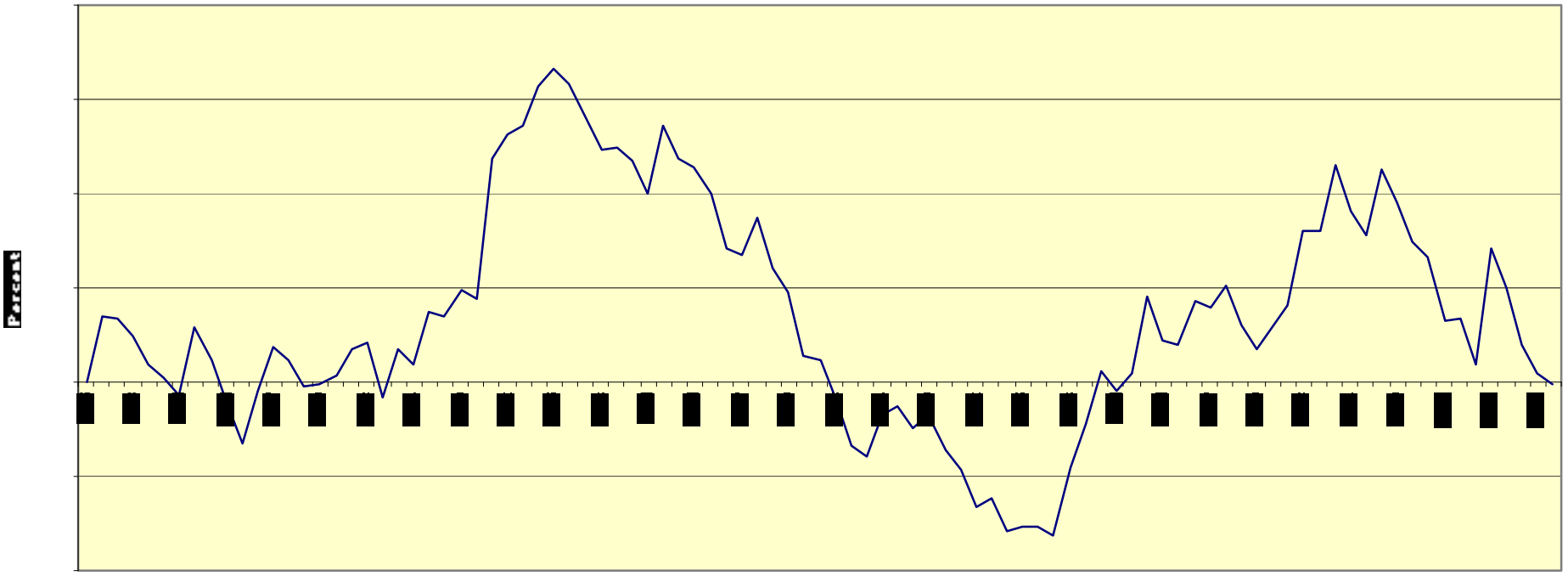
San Diego Rainfall

1915-2009



Accumulated Departure From Mean Rainfall at San Diego

1915-2009



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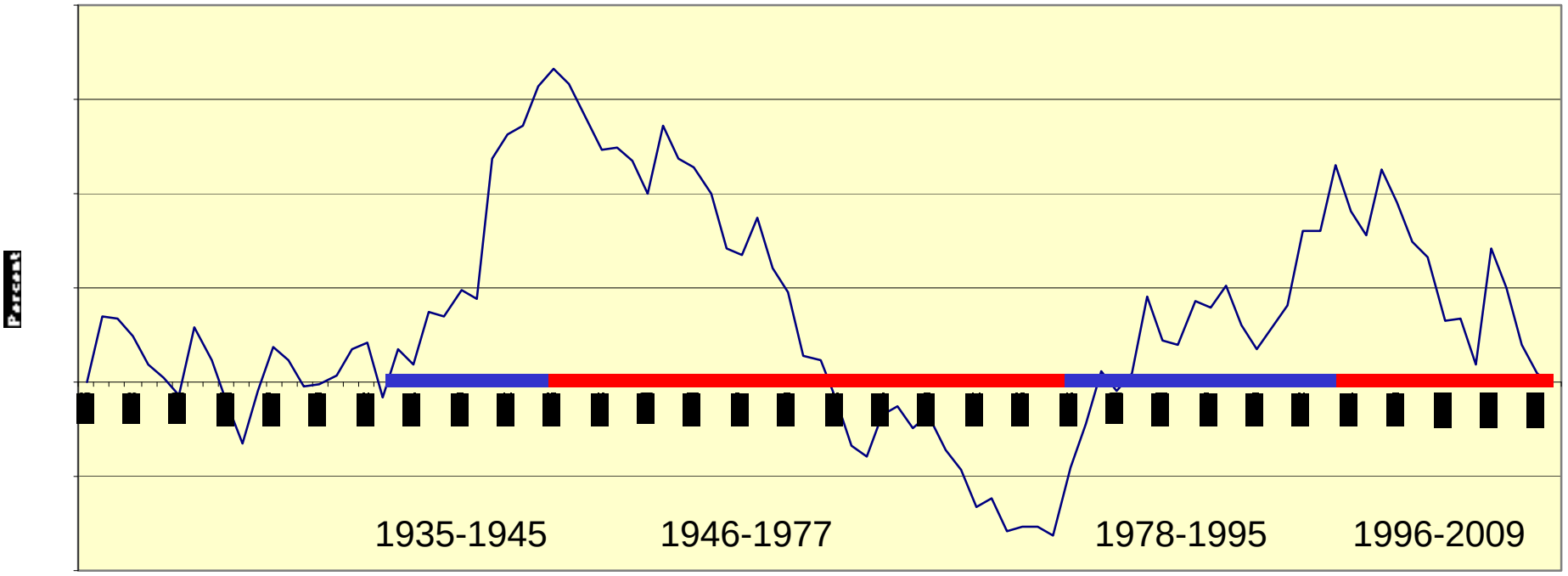


Geology

Porosity & Permeability

- Porosity is the ability of a rock to contain water.
- Permeability is the ability of water to move through a rock.

Porosity

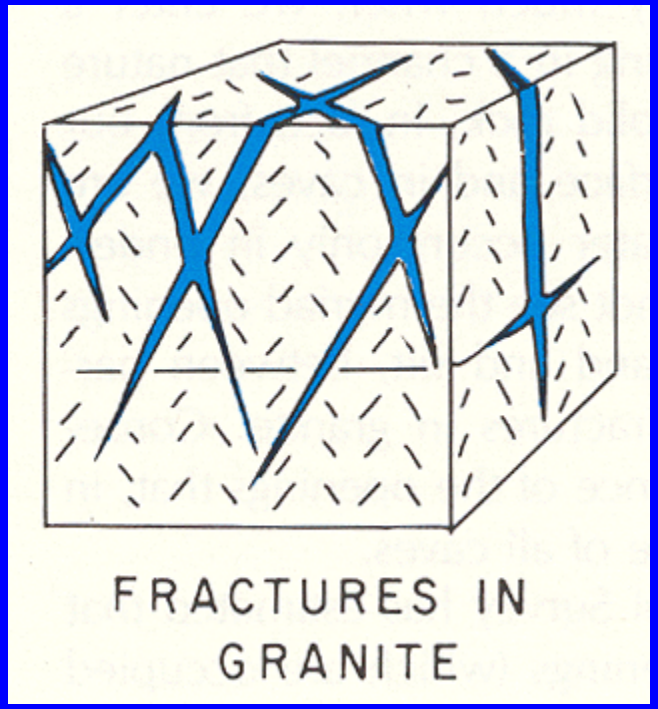
- Almost all shallow rocks contain pore space.
- Water infiltrates into the pore space.

Fractured Rocks

Highway 2, Rumorosa Grade, Baja California

Porosity Consolidated Rock

- Unfractured crystalline rock.....<1%
- Fractured crystalline rock.....<10%



Heath 1983

Weathered & Decomposed Rock

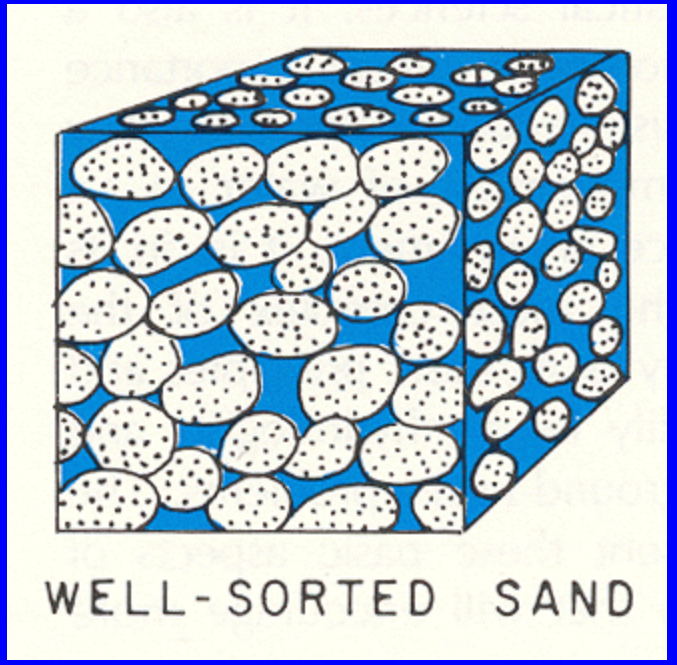
- Porosity……30-60%

Unconsolidated Rock

San Pasqual Valley

Porosity Unconsolidated Rocks

- Gravel……25-40%
- Sand……25-50%
- Silt……35-50%
- Clay……40-70%



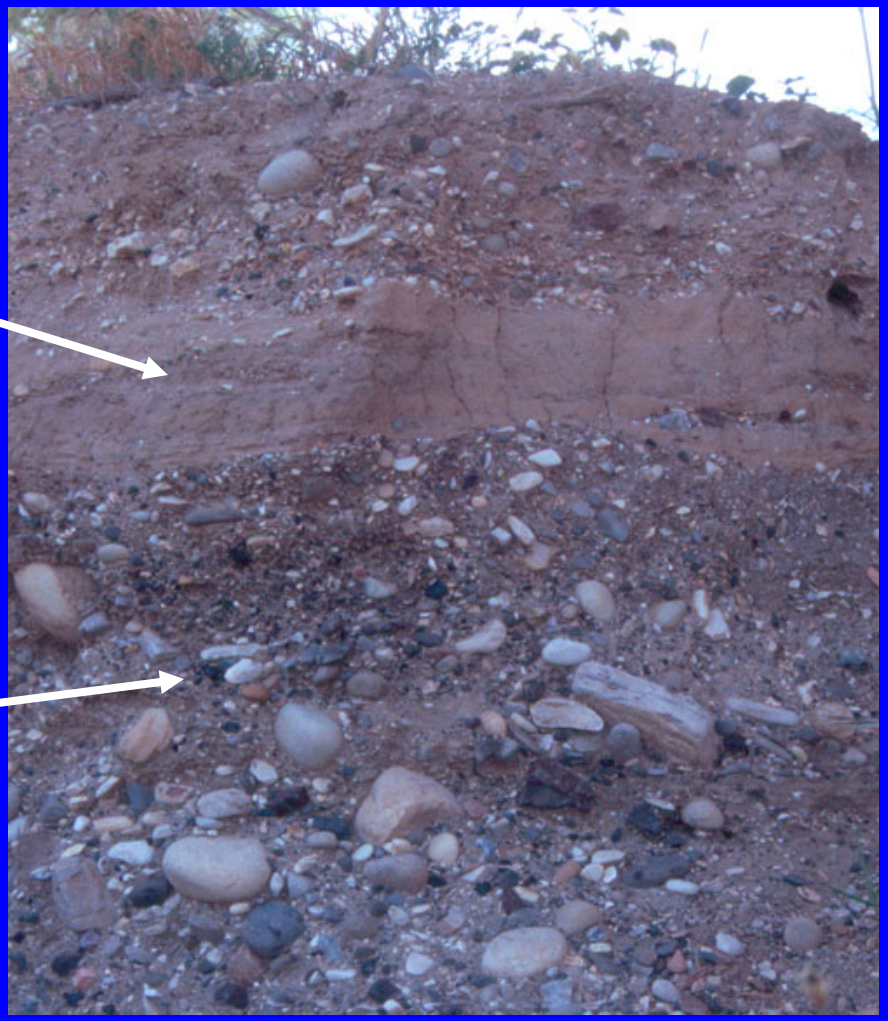
Heath 1983

Permeability

- Sands & Gravel are highly permeable.
- Silt & clay have low permeability.
- Fractured rock is variable.
- Weathered granitic rock (residuum) is commonly clayey, with relatively low permeability.

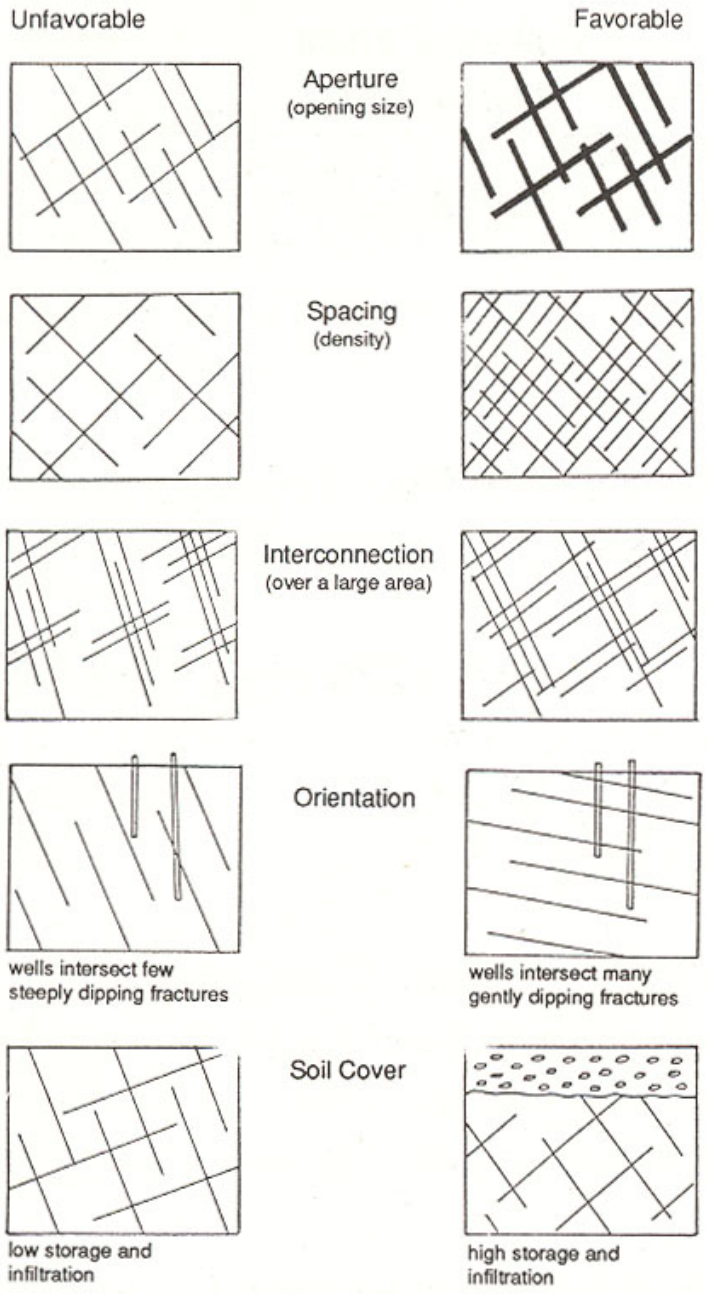
Groundwater

Clay has low permeability

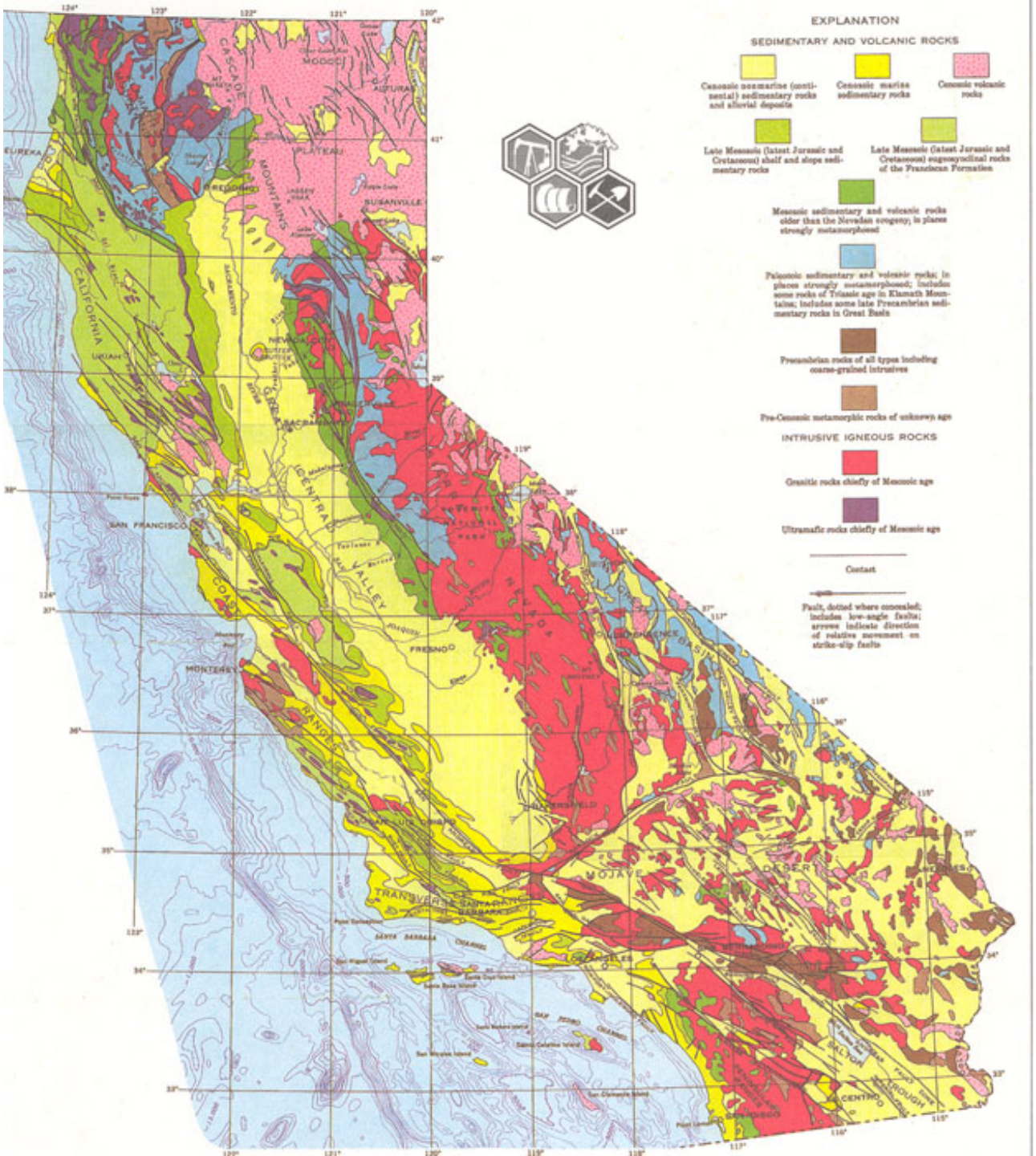


Sand and gravel have high permeability

Fracture System Characteristics Controlling Ground Water Development



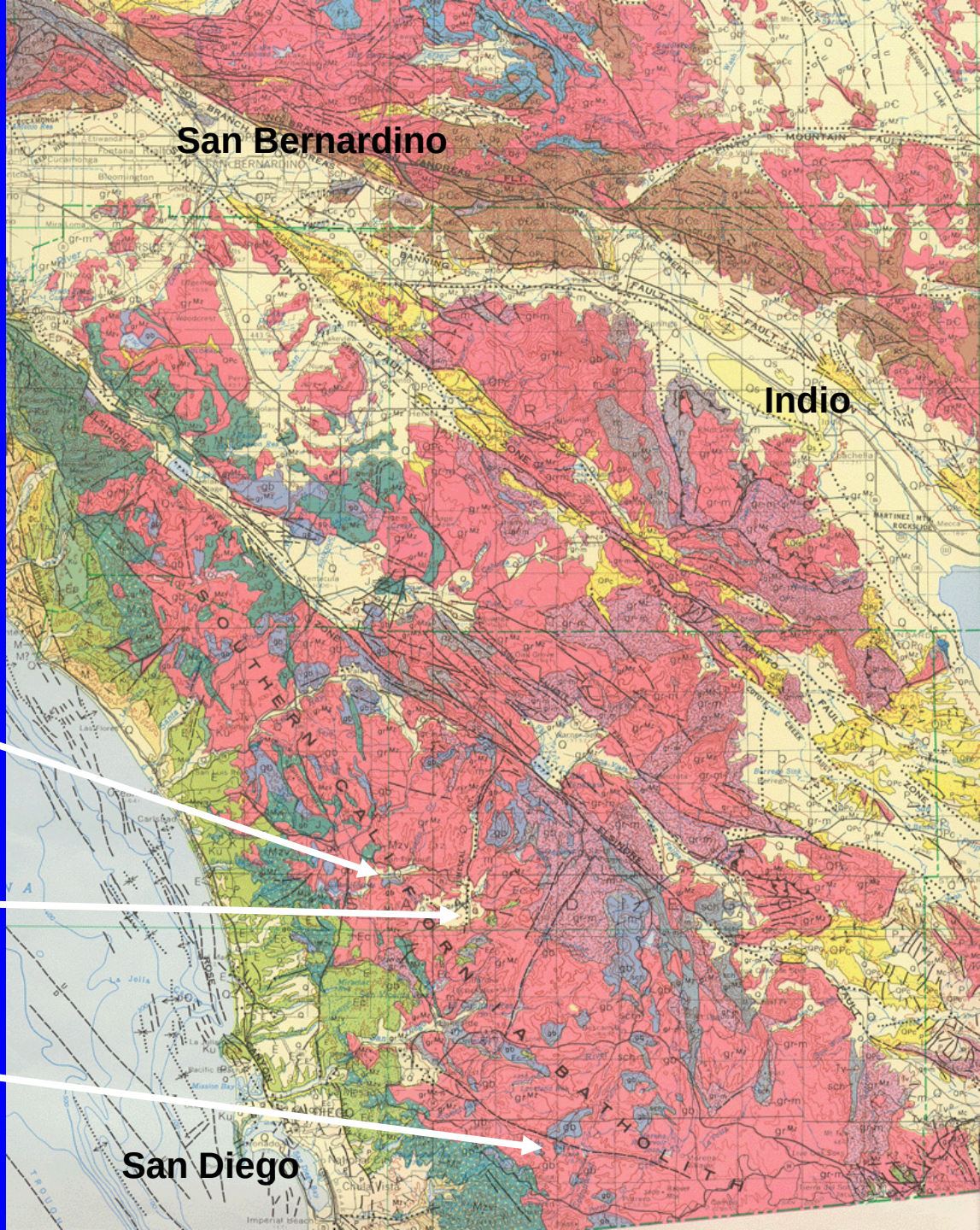
California's Geology & Groundwater Resources


EXPLANATION
SEDIMENTARY AND VOLCANIC ROCKS
Cenozoic nonmarine (continental) sedimentary rocks and alluvial deposits
Cenozoic marine sedimentary rocks
Cenozoic volcanic rocks
Late Mesozoic (latest Jurassic and Cretaceous) shelf and slope sedimentary rocks
Late Mesozoic (latest Jurassic and Cretaceous) eugeosynclinal rocks of the Franciscan Formation
Mesozoic sedimentary and volcanic rocks older than the Nevadan orogeny; in places strongly metamorphosed
Paleozoic sedimentary and volcanic rocks; in places strongly metamorphosed; includes some rocks of Triassic age in Klamath Mountains; includes some late Precambrian sedimentary rocks in Great Basin
Precambrian rocks of all types including coarse-grained intrusives
Pre-Cenozoic metamorphic rocks of unknown age
INTRUSIVE IGNEOUS ROCKS
Granitic rocks chiefly of Mesozoic age
Ultramafic rocks chiefly of Mesozoic age
Contact
Fault, dotted where concealed; includes low-angle faults; arrows indicate direction of relative movement on strike-slip faults
CASCADE
MODOC
PLATEAU
KLAMATH
MOUNTAINS
SUSANVILLE
EUREKA
CALIFORNIA
NEVADA
SACRAMENTO
SAN FRANCISCO
CENTRAL
VALLEY
FRESNO
MONTEREY
COAST
RANGES
TRANSVERSE RANGES
SANTA BARBARA
CHANNEL
LOS ANGELES
MOJAVE
DESERT
SALTON
TROUGH
EL CENTRO
SAN DIEGO

California's Groundwater Basins

- About 500 basins.
- Mostly underlie alluvial-filled valleys.
- Provide most groundwater storage & supply.

Regional Geology



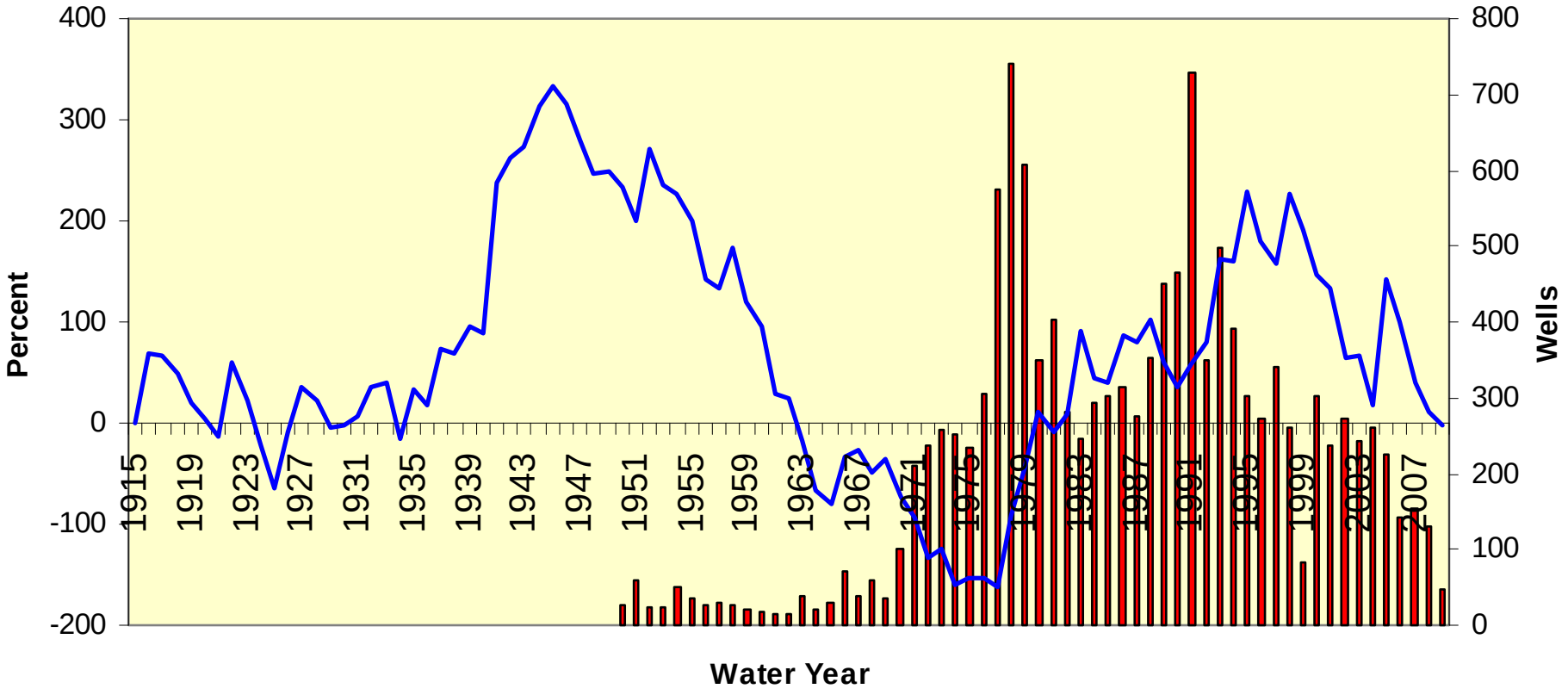
San Pasqual Valley

Santa Maria Valley

Lee Valley

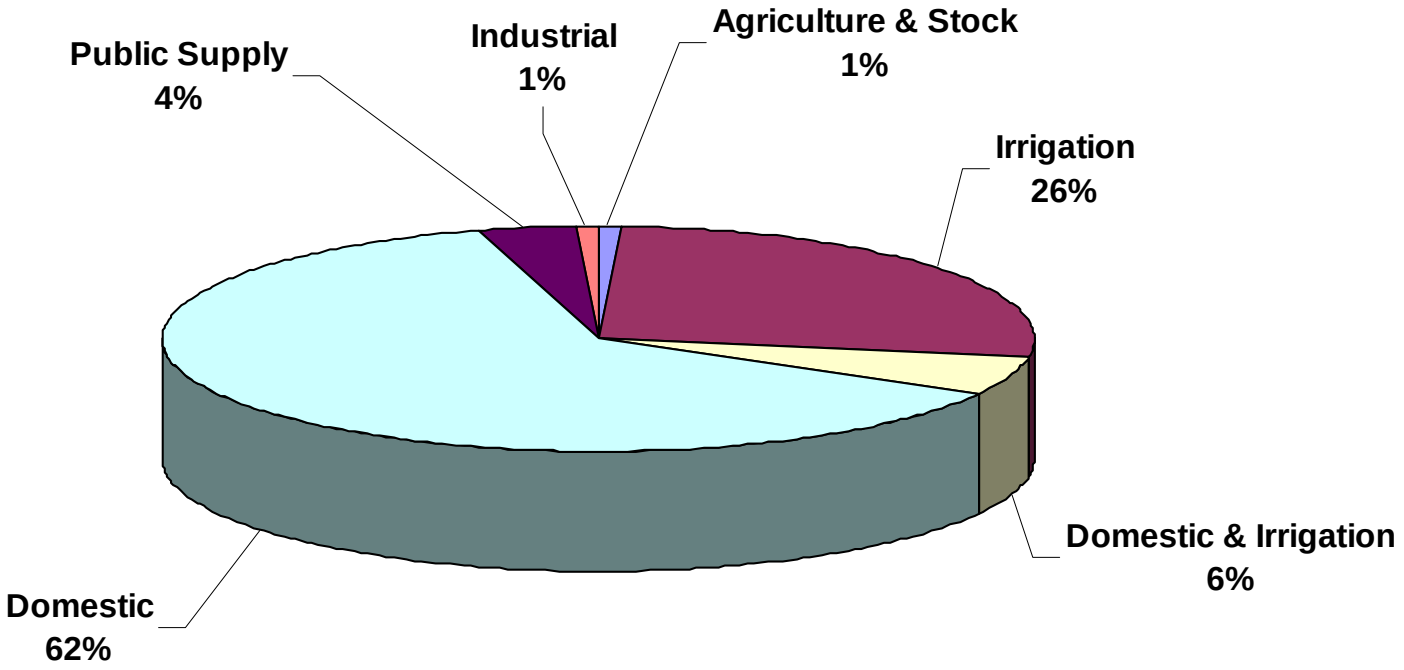
How many water wells have been drilled in San Diego County?

Water Wells Completed in San Diego County



How is the groundwater used in San Diego County?

Use of Wells in San Diego County



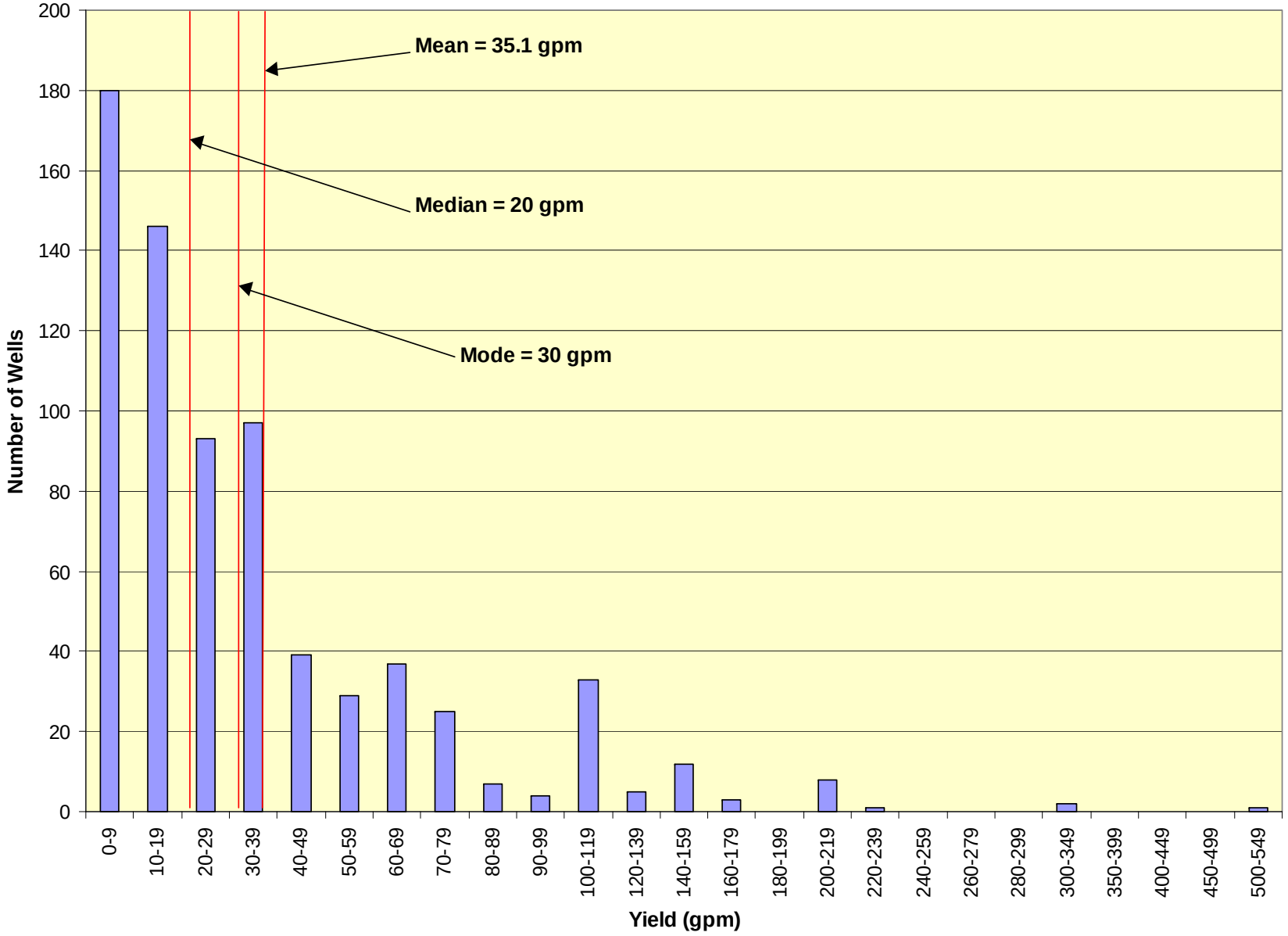
San Diego County Water Wells

Use	Maximum Depth (feet)	Maximum Yield (gpm)
Domestic	2010	2500
Domestic & Irrigation	1816	3400
Irrigation	2774	3670
Agricultural or Stock	1305	2100
Industrial	1245	1500
Public Supply	1530	2000

How much water do the wells yield in San Diego County?

Example from Ramona

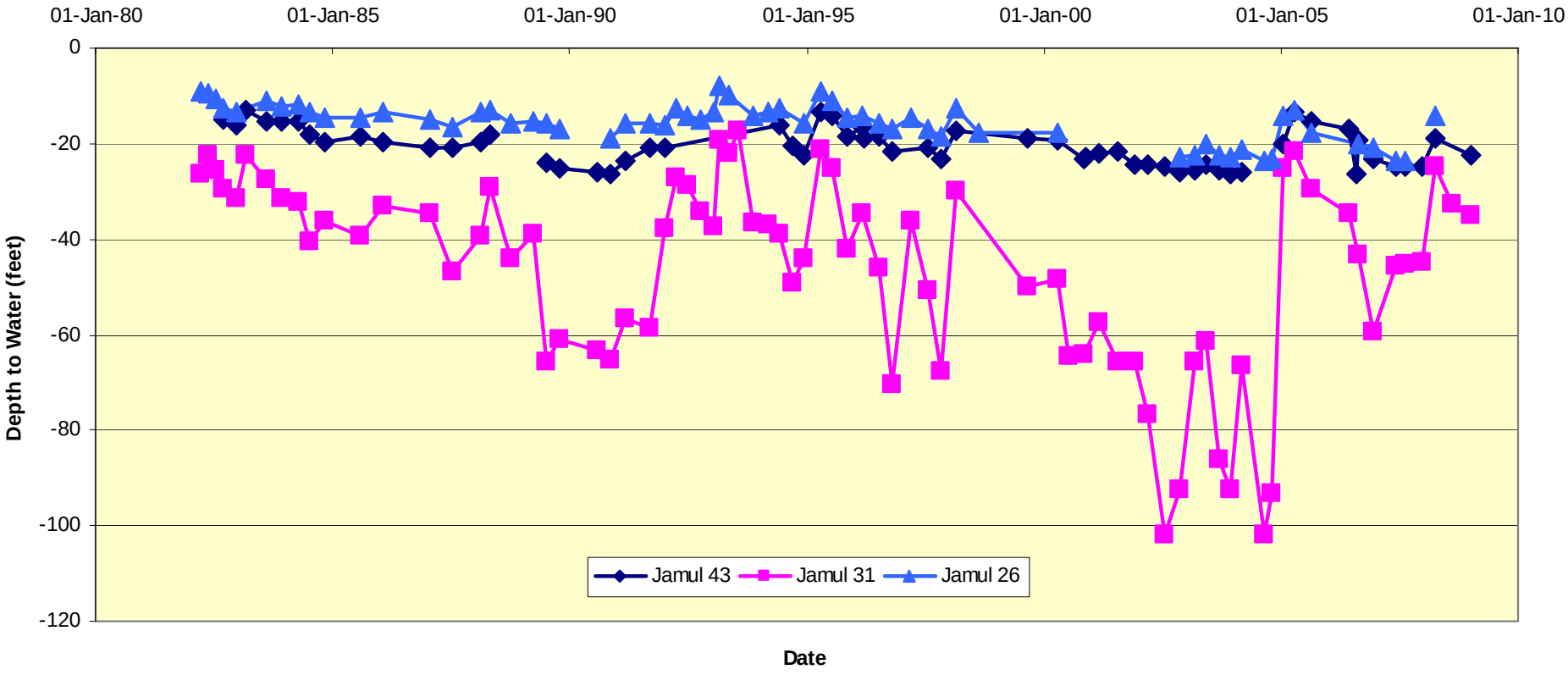
Yield of Water Wells in 13S01E



Groundwater Levels in San Diego County

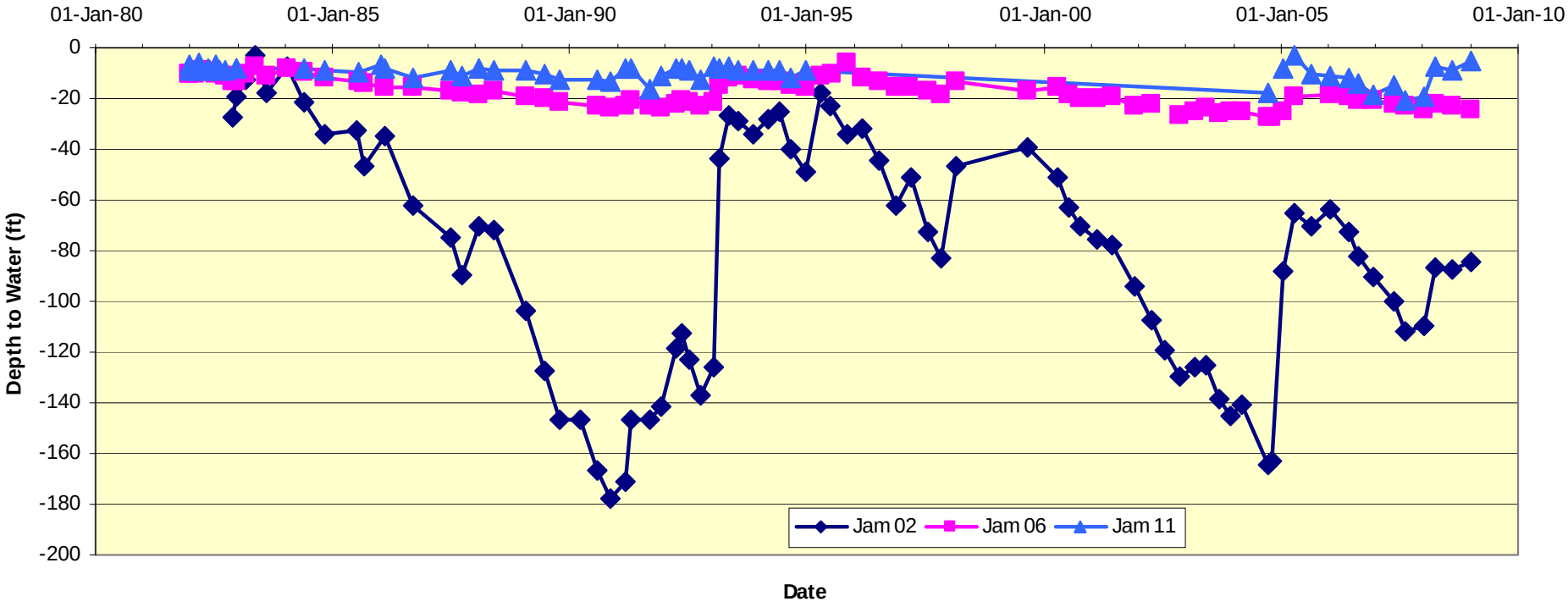
Groundwater Levels in Jamul

Lawson Valley, T16S R02E



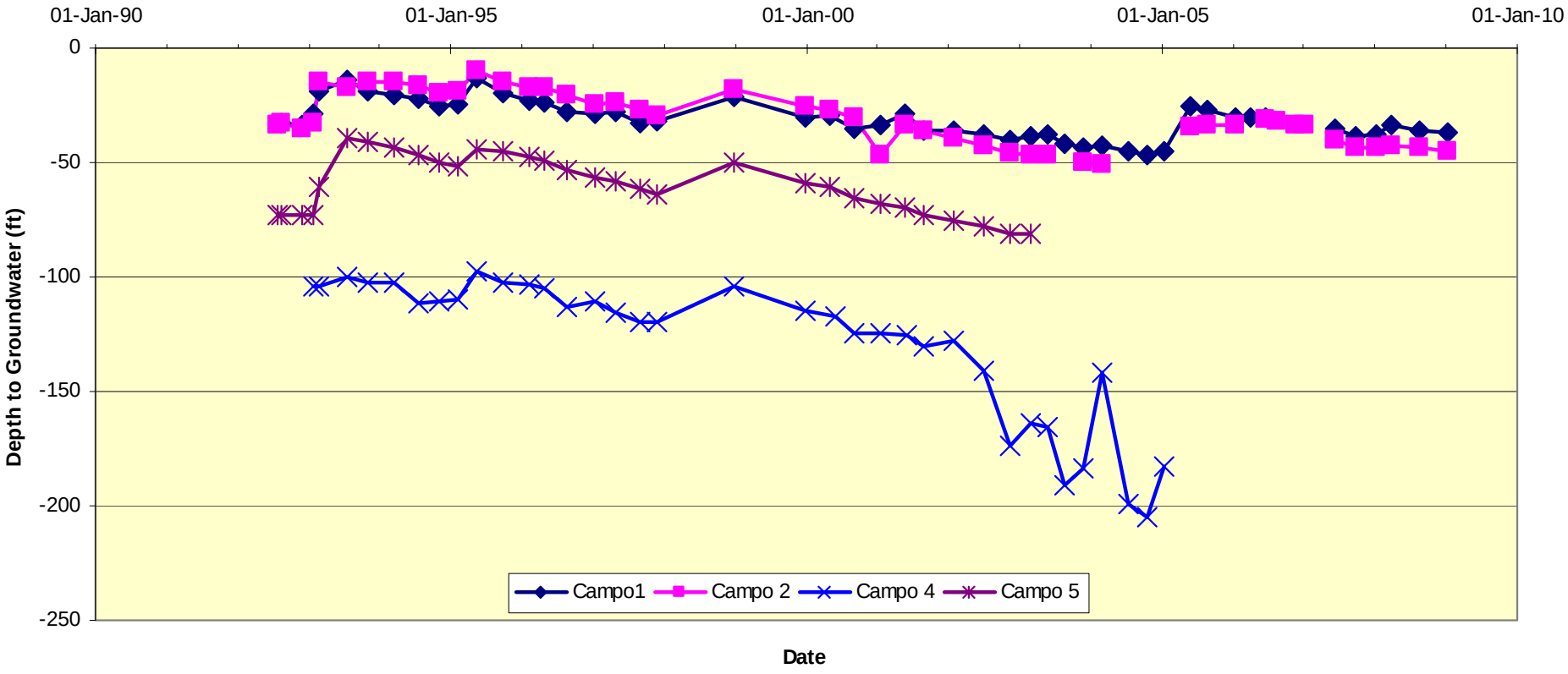
Groundwater Levels in Jamul

Honey Springs Road, T17S R02E

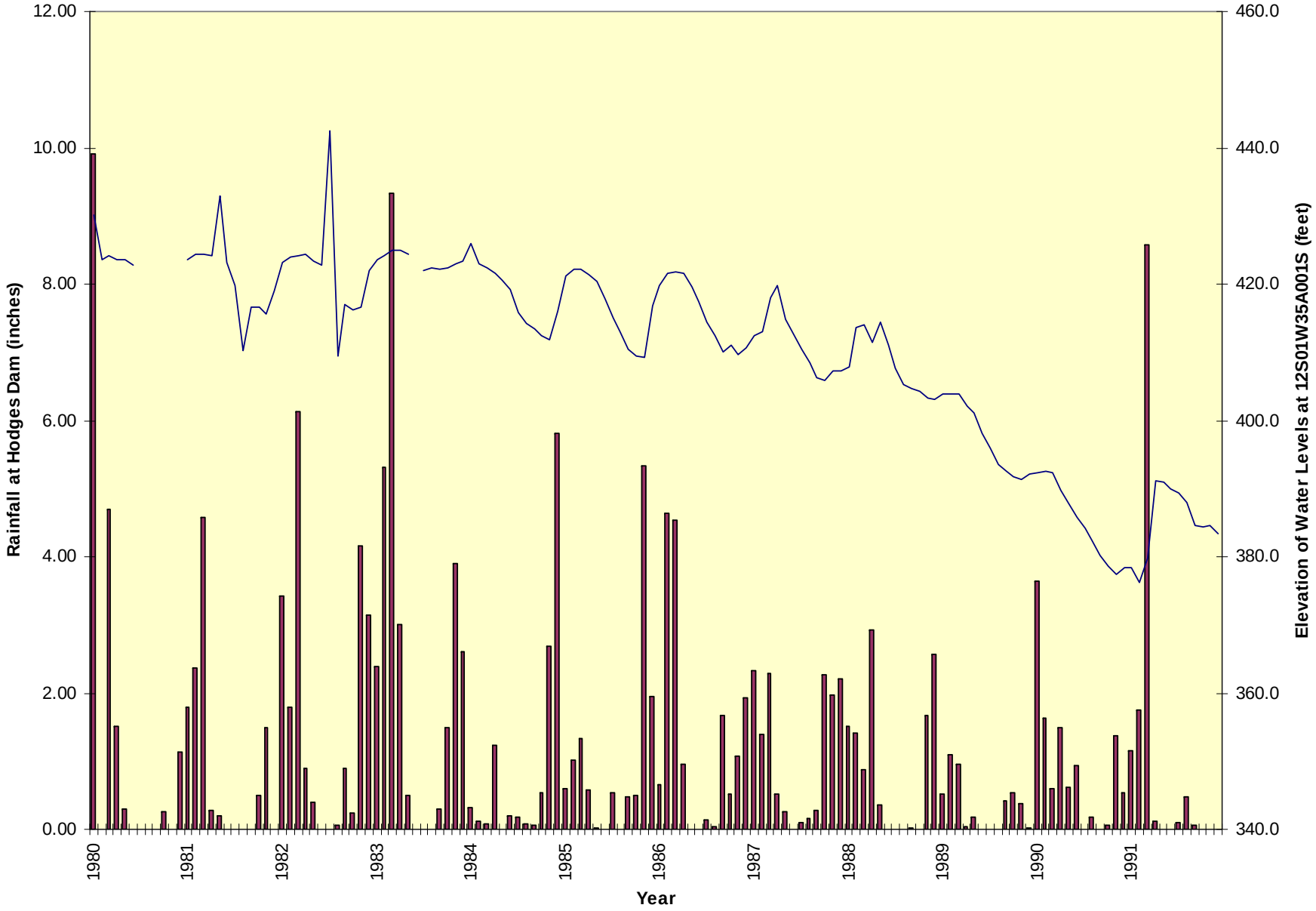


Groundwater Levels in Campo

Morena Village, T17S R05E

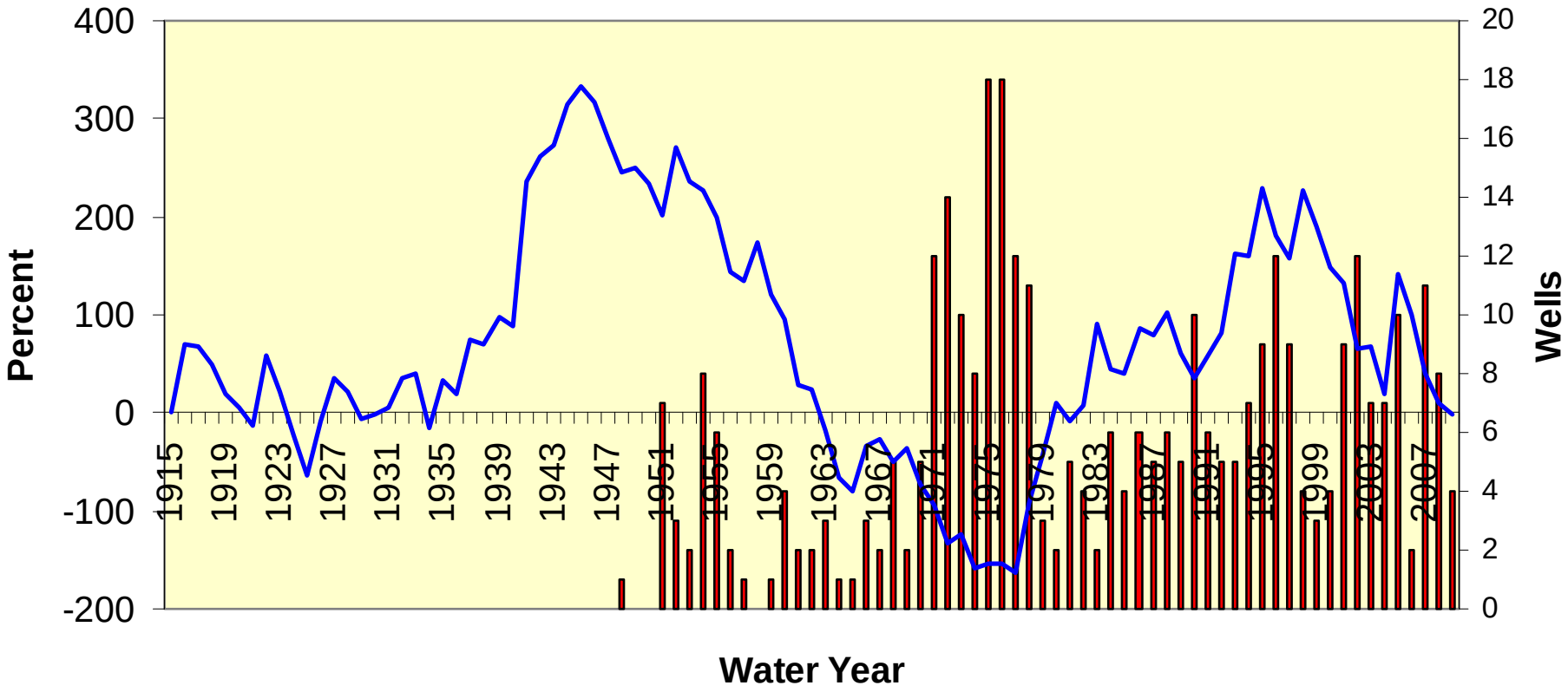


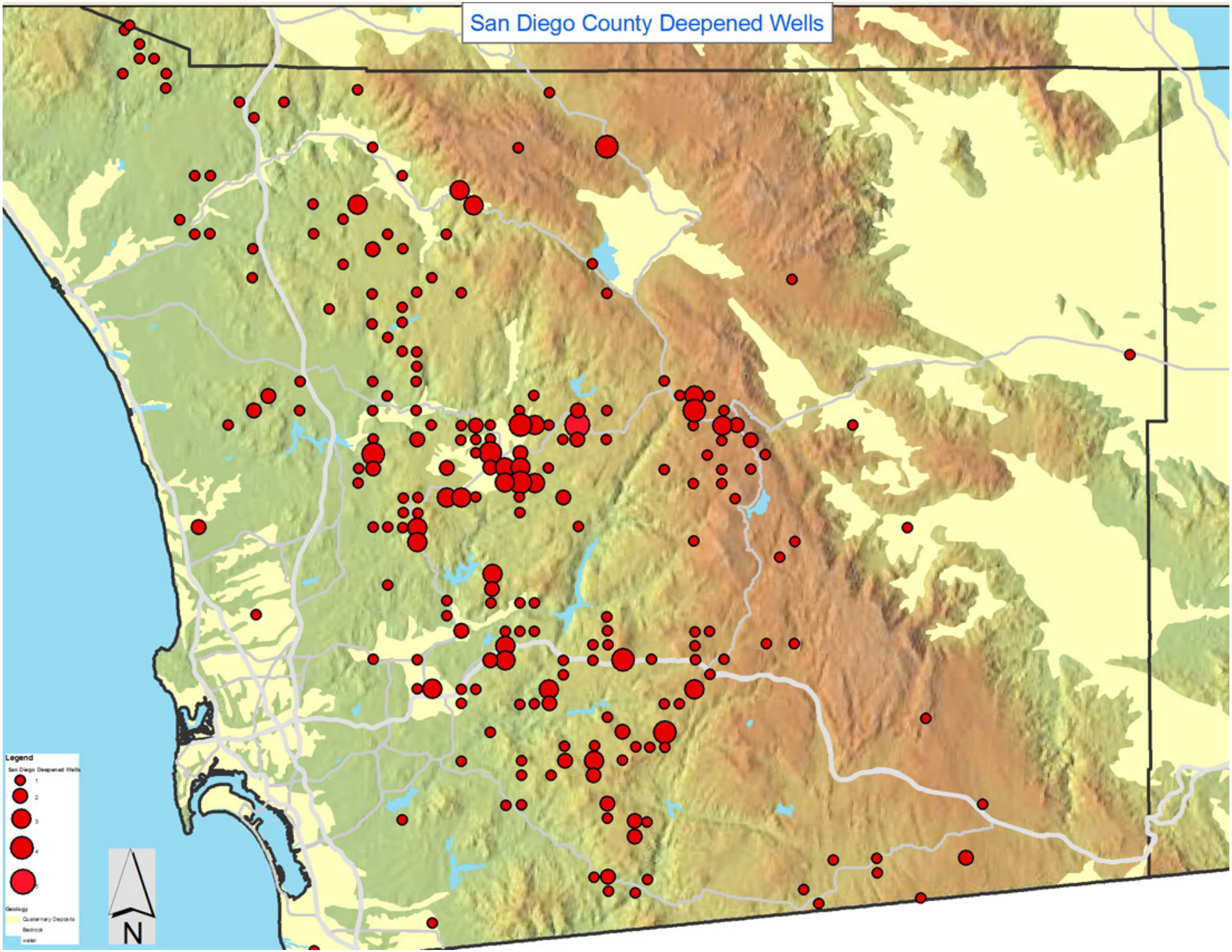
Impact of Rainfall on Groundwater Levels - San Pasqual Valley

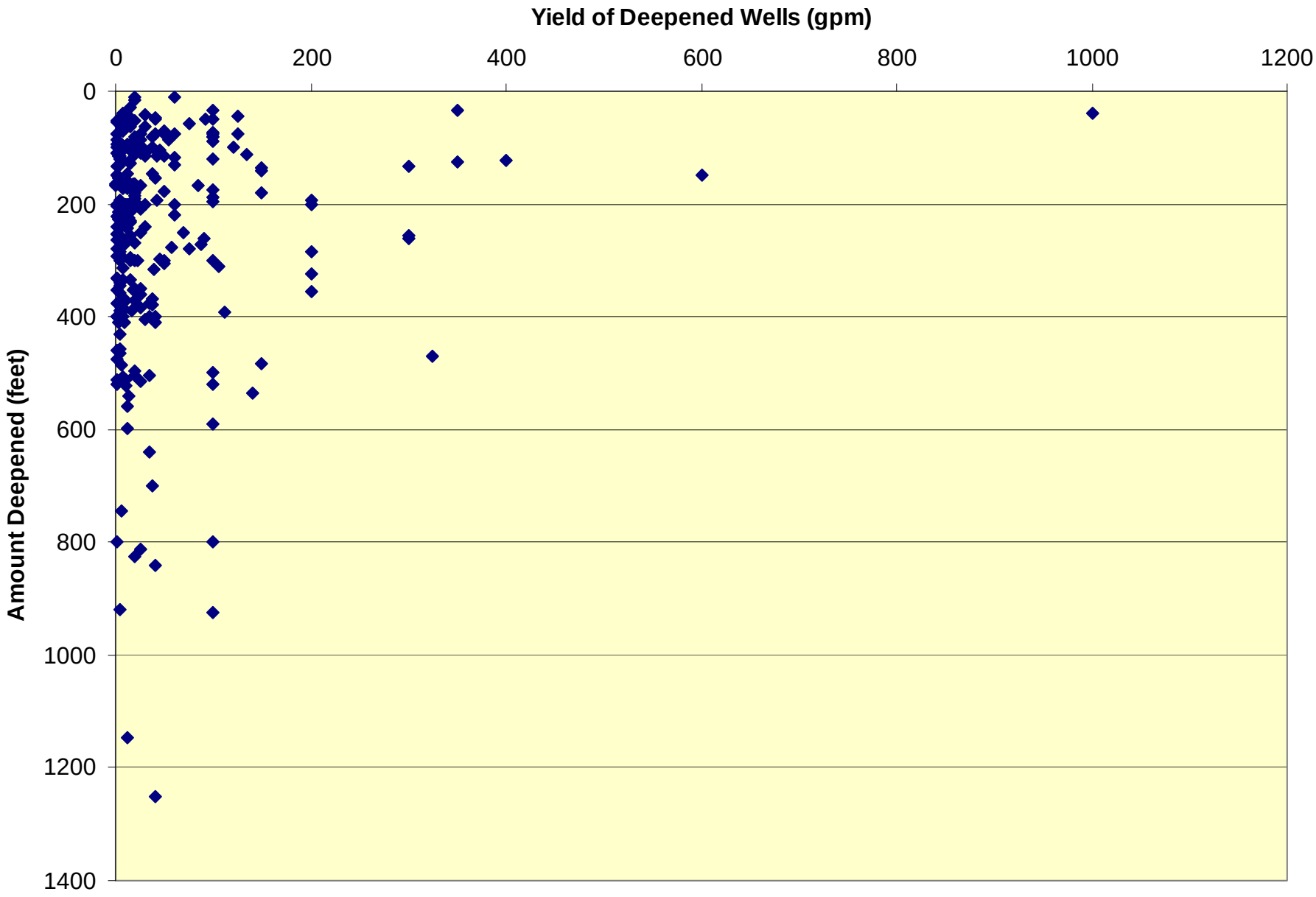


When & where were water wells deepened in San Diego County?

Deepening of Water Wells




San Diego County Deepened Wells
Legend
San Diego Deepened Wells
1
2
3
4
5
Geology
Quaternary Deposits
Bedrock
water
N


Yield of Deepened Wells (gpm)
0
200
400
600
800
1000
1200
Amount Deepened (feet)
0
200
400
600
800
1000
1200
1400

Conclusions

- Rainfall
  - Relatively low (~10 in/yr)
  - Highly variable
- Mostly fractured-rock aquifers
  - Mostly low yielding wells
- Unconsolidated aquifers
  - Few
  - Mostly small
  - Larger basins (e.g., Borrego) get little recharge

Conclusions

- Groundwater level data
  - Fractured wells highly variable
  - Alluvial basins fluctuate with rainfall
- Well deepening
  - Mostly during dry years
  - Results are mixed

For Further Information Contact:

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